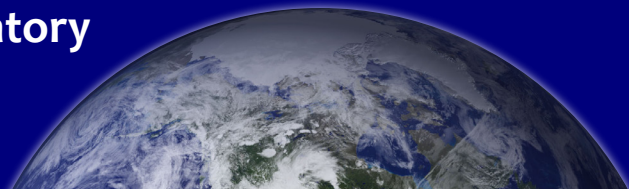




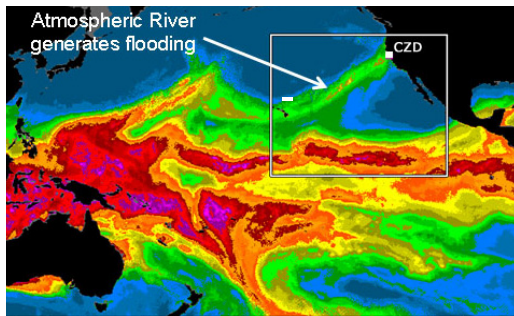
# Earth System Research Laboratory

## Physical Sciences Division

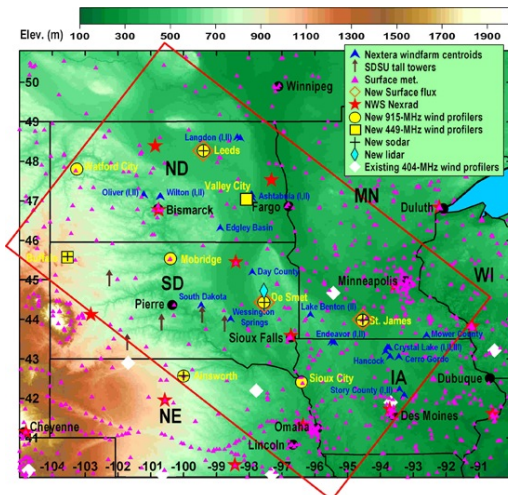
*Diagnosing the weather-climate system*



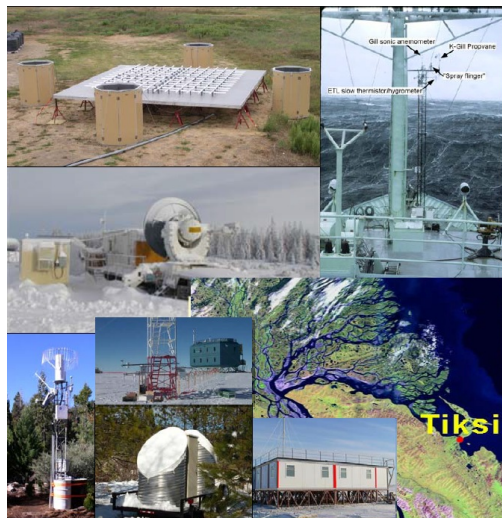
**Water: Too much.** Working with meteorologists, climatologists and others to improve observation and forecasting of severe land-falling storms that cause flooding in U.S. western coastal areas:



**Advancing** the goal of a network of networks for regional weather forecasting – applications to wind energy:



**Improving** our ability to observe the Earth system:



## What Does The Physical Sciences Division Do For The Nation?

The **Physical Sciences Division (PSD)** of the Earth System Research Laboratory (ESRL) analyzes and interprets physical processes that influence weather and climate variations from days to decades, and works with partners in other federal and state agencies and universities to provide scientific information necessary for cost-effective decision making. A major effort is to improve predictions on weather-to-climate time scales by identifying early warning indicators in atmosphere and ocean patterns that could cause extreme events (such as floods, droughts, and heat waves). To do this we develop new tools including new observing technology and methods to evaluate the accuracy of computer models of the Earth System.

## In-House Partners

PSD hosts the program management for the National Integrated Drought Information System (NIDIS) and the Western Water Assessment, part of NOAA's Regional Integrated Science and Assessment (RISA) program. PSD also leads NOAA's Hydro-meteorology Testbed (HMT). These collocated activities motivate and link water research (forecasting too much or too little) to societal needs.

## Other Partners

- Bureau of Reclamation
- California Department of Water Resources
- NOAA National Marine Fisheries Service / Fisheries Science Centers
- NOAA National Weather Service / Office of Hydrological Development
- Scripps Institution of Oceanography
- Sonoma County Water District
- U. S. Army Corps of Engineers
- Western States Water Council

## What does PSD do?

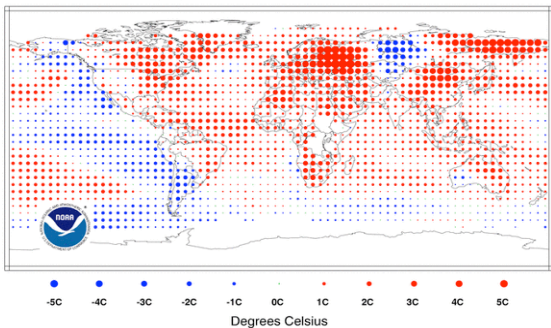
- Mounts major field programs around the globe from the oceans to the Poles.
- World leaders in observing and measuring the behavior of the atmosphere over land, oceans, ice, and snow.
- Studies Earth system processes in NOAA's challenge areas of water, climate variability, and extreme events.
- Identifies early warning indicators in the Earth system that can help improve predictions at extended time scales.
- Pioneers new methods to explain weather and climate events of significant public interest based on rigorous evaluation of observed conditions and state-of-the-art computer simulations.
- Leads the project to reconstruct the Earth's atmospheric weather and climate patterns using only surface pressure data back to 1870 putting today's weather and climate extremes in the context of the past.
- Develops unique observing technologies and distributes new products from our data and analyses, for applications such as water resource management and wind energy.
- Advances model physics and evaluates the performance of model results across time scales.
- Helps NOAA formulate its scientific vision and contributes to national and international assessments (led two recent NOAA Science Challenge Workshops).

## A Tale of Two Extremes

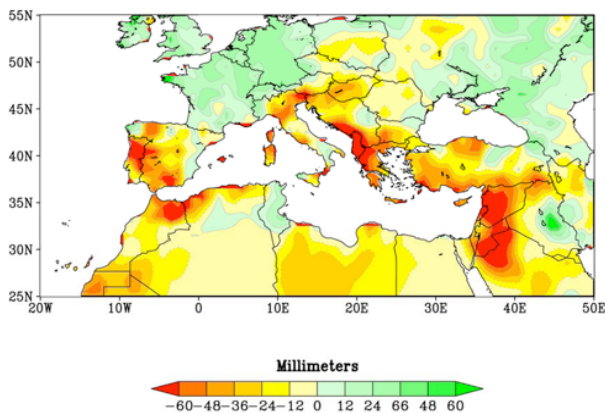
### Understanding the Reasons for Extreme Events and Climate Trends to Guide Decision Making

#### Temperature Anomalies July 2010

(with respect to a 1971-2000 base period)  
National Climatic Data Center/NESDIS/NOAA



**The Russian heat wave of 2010** was due primarily to a natural atmospheric phenomenon often associated with weather extremes called an atmospheric “blocking pattern”. This strong, stationary, high-pressure system prevented summer storms and cool air into the region and led to the extreme hot and dry conditions. The intensity of this heat wave is a “climate surprise,” expected to occur only very rarely in current climate, minimizing the need for near-term adaptation. Climate models project an increase in the risk of such heat waves in western Russia, from less than one percent in 2010, to 10 percent or more by the end of the 21st century.



**Wintertime droughts** are increasingly common in the Mediterranean region: in the last 20 years, 10 of the driest 12 winters have taken place in the lands surrounding the Mediterranean Sea. The amount and frequency of the drying that has occurred is too great to be explained solely by natural variations, and natural variability alone is unlikely to return the region’s climate to normal. Greenhouse-induced climate change has caused somewhat greater warming of the tropical oceans compared to other ocean regions – a pattern that drives drought-conducive weather patterns around the Mediterranean. Climate models predict an increased risk of drought, indicating the need to begin implementing adaptation to reduced water resources from climate change.

## What’s Next For PSD?

During the next five to ten years, PSD will continue to support NOAA by:

- Addressing recent extremes in terms of underlying causes and evaluating pathways for improved prediction;
- Advancing the use of hydrometeorology testbeds in other large water sheds of the United States to deliver improved scientific information for water resource management and protection of lives and property;
- Improving understanding of the physical processes underlying short-term climate variations and long-term trends to improve predictions;
- Improving observation and understanding of physical processes in polar regions, especially as related to impact on the mid-latitude weather and extremes;
- Improving physical understanding of the causes of regional climate variations and impacts, such as those associated with droughts and floods, and evaluating model performance in their forecasting; and
- Developing regionally-specific information and forecast products.



### Contact:

Dr. William D. Neff, PSD Director  
325 Broadway  
Boulder, Colorado 80305  
303-497-6265